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The effectiveness of the realistic math education (RME) learning method based on manipulative media in improving the problem-solving abilities of elementary school students

Ufi Puspita Sari Umar [a,1,*], Zakaria [a,2]

[a] Institut Agama Islam Negeri Bone, Jl. HOS Cokroaminoto, Bone, Indonesia
[1] ufipuspitasariumar@gmail.com; [2] zakaria@gmail.com*
* Korespondensi Penulis

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ABSTRACT

This study aims to determine the profile of students' mathematical problem solving abilities before and after being taught using the Manipulative Media-Based Realistic Mathematic Education (RME) method, the effectiveness of the Manipulative Media-Based Realistic Mathematic Education (RME) method in improving students' mathematical problem solving abilities, and differences in solving abilities students' mathematical problems between before and after the application of the Realistic Mathematical Education (RME) learning method. This research is a quantitative pre-experimental design. The research design used is the One Group Pretest-Posttest Design pattern. This design has a pretest, before being given treatment. The data collection technique in this study used a multiple-choice test technique. The data in this study were analyzed using descriptive and inferential statistical analysis techniques. The results of this study indicate that the problem-solving abilities of students before being taught the Realistic Mathematics Education (RME) method based on manipulative media have an average value of 35.00, a standard deviation of 15.022 with a completeness percentage of 8% and after applying the Realistic Mathematical Education method (RME) based on manipulative media students' problem solving abilities have an average of 84.20, a standard deviation of 8.602 with a completeness percentage of 92%; learning using the Realistic Mathematical Education (RME) method based on manipulative media is effective in improving students' problem solving abilities in mathematics; and there are differences between before and after the implementation of the Realistic Mathematical Education (RME) method based on manipulative media.

1. Introduction

Mathematics is a very universal subject, so mathematics should be easy for students to learn. But in fact, some of the students consider mathematics as a difficult subject. For the last three years Indonesian students have experienced difficulties in solving math problems that require problem solving skills. The 2018 PISA results show that 71% of Indonesian students still have difficulty dealing with situations that require problem-solving skills using mathematics (Kartianom Kartianom & Ndayizeye, 2017; Niss, 2015). In 2019, the results of the AKSI Report show that 79.44% of Indonesian students are not yet able to reason to solve complex and non-routine problems based on their mathematical concepts (K Kartianom & Retnawati, 2018a, 2018b; KEMDIKBUD, 2019). This proves that Indonesian students have difficulty solving math problems that require problem solving skills. A decrease in students' math scores also occurred at SD Negeri 4 Manurungnge, Bone Regency. In 2020 the average score obtained by students was 76, and in 2021 there was a decrease in the average student score to 75. The cause of the decline in learning achievement was the low ability of students to solve problems in learning mathematics and because the teacher only used one method of learning, the lecture method (Ilyas & Salwah, 2017; H. Retnawati, Djidu, Kartianom, Apino, & Anazifa, 2018). To overcome problems in learning mathematics, various methods of learning mathematics are carried out. One method that can be applied in learning mathematics is the Realistic Mathematical Education (RME) method.

Previous research related to the use of the Realistic Mathematical Education (RME) method on students' low ability to solve problems in mathematics tends to analyze three things. First, the RME method is associated with an increase in student learning outcomes. This kind of research has succeeded in providing information about the importance of the real context and the process of constructing mathematical knowledge (Arfiani, Ulya, & Wanabuliandari, 2020). The teacher's efforts in linking mathematics with the real world of students. As well as the development of appropriate and effective learning methods (Murni, Sabandar, S. Kusumah, & Kartasamita, 2013). Second, the application of Realistic Mathematics Education learning to increase students' motivation to learn mathematics. This kind of research has succeeded in providing information on how to increase students' enthusiasm for learning and courage in solving problems in learning mathematics (Jang & Lee, 2013). Knowing the use of mathematics in general for humans and the steps how students solve a problem. The role of the teacher in implementing effective and efficient learning and the way the teacher deals with problems that occur in the learning process. Third, Improving Local Excellence-Based Problem-Solving Ability with the Realistic Mathematical Education (RME) Method Assisted by Batar Puzzle Media in Class V Students. This kind of research has succeeded in providing information about teacher creativity in utilizing learning media (batar puzzle media) (Nasution, 2018). How to relate the RME method with the use of fun and easy math comic media on mathematics learning outcomes. How to improve mathematics learning activities using the Realistic Mathematical Education (RME) method assisted by concrete media. Of the three previous trends, there are not many who link students' problem-solving abilities with student learning motivation using the Realistic Mathematical Education (RME) method based on manipulative media.

This research is based on an argument that the low ability of students' problem solving in mathematics is the result of the use of inappropriate learning methods and media. The learning process is carried out interactively, fun, challenging, motivating, according to talents, interests, and physical and psychological development (Park, 2021; Sekarwangi, Sartono, Mustadi, & Abdulah, 2021). Whether or not a student is able to solve problems, especially in mathematics, depends on the method or learning media used by the teacher. If the teacher uses the right learning method, the more effective the learning process will be. This is because the learning method can be used as a tool in fostering student learning motivation. Effective learning is also inseparable from the use of learning media, because the use of appropriate learning media can make lessons more interactive and interesting (Nurjamaludin, Gunawan, Adireja, & Alani, 2021).

This research specifically aims to fill the gap from previous research by providing information regarding the effectiveness of the manipulative media-based Realistic Mathematics Education (RME) learning method in improving students' mathematical problem-solving skills. It is hoped that the information from this research can become the basis for policy making by educational actors to improve the problem-solving abilities of students at the elementary school level.

2. Method

2.1. Types of Research

The type of research used by researchers is quantitative research. Quantitative research is research that is meant to reveal symptoms holistically-contextually through collecting data from natural backgrounds by utilizing the researcher himself as a key instrument (Kartianom Kartianom & Mardapi, 2018; Kartianom Kartianom & Ndayizeye, 2017; Taghizadeh-Yazdi, 2015). Quantitative research is descriptive in nature and tends to use an inductive analysis approach (Lubin et al., 2022; H. Retnawati et al., 2018; Heri Retnawati, Djidu, Apino, Kartianom, & Anazifa, 2018). While the research design used by researchers is one sample group pretest-post test.

2.2. Time and Place of Research

This research took place at SDN 4 Manurungnge, Tanete Riattang District, Bone Regency. SDN 4 Manurunge is a public elementary level education institution, located on Jalan Kawerang, Manurunge Village, Tanete Riattang District, Bone Regency.

2.3. Population and Sample

Population is the entire object that will or wants to be studied. The population is also known as the universe. Members of the population can be living things, inanimate objects, and humans. Where the properties that exist in it can be measured or observed. The population in this study were all students of SDN 4 Manurungnge with a total of one hundred and sixteen students. The sample is part of the number and characteristics possessed by the population or a small part of the population members taken according to certain procedures so that they can represent the population. The sampling technique used by researchers is a non-random sampling technique, namely purposive sampling (destination sample). Purposive Sampling is used if the target sample under study already has certain characteristics so that it is impossible to take other samples that do not meet the predetermined characteristics. The samples for this study were fifth grade students at SDN 4 Manurungnge with a total of twenty-five students, eleven male students and fourteen female students.

2.4. Data Collection Techniques

To obtain research data, the data collection technique used is a multiple-choice test technique and an essay. There are two test instruments used in this study, namely the pre-test instrument and the post-test instrument. The pre-test instrument is used to measure students' abilities before being given treatment. The post-test instrument is used to measure students' abilities after students are given learning treatment using the Realistic Mathematical Education (RME) Method Based on Manipulative Media.

2.5. Data Analysis Techniques

Data analysis techniques used in this study are descriptive and inferential statistics. Descriptive statistics, namely statistics that study procedures for collecting, compiling, presenting, and analyzing research data in the form of numbers, to provide an orderly, concise, and clear picture of a phenomenon, situation, and event so that certain meanings can be drawn. Inferential statistics (inferential statistics), namely statistics that study or prepare procedures for drawing conclusions about population characteristics, based on quantitative data obtained from research samples. Inferential analysis is also used statistically to research the proposed research hypothesis and to answer the stated problem formulation. Before carrying out the hypothesis test, an assumption test is first carried out which consists of a normality test and a hypothesis test.

3. Results and Discussion

3.1. Result

3.1.1 Descriptive Data Analysis

The learning method is said to be effective in terms of students' problem-solving abilities in mathematics if the overall average score of students is at least 70. Data on students' problem-solving ability test results in mathematics in the pre-test and post-test can be seen in Table 1.

Table 1. Description of Students' Problem Solving Ability

Descriptive	Pre-Test	Post-Test
Mean	35.00	84.20
SD	15.02	8.60
Min	12	68
Max	72	100
KKM	8%	92%

Based on Table 1, information was obtained that the pre-test average score for students' mathematical problem-solving abilities was 35.00, which increased by 49.2 to 84.20 in the post-test (after the application of the Manipulative Media-Based Realistic Mathematics Education method). In addition, based on the percentage of learning completeness of students before the application of the Manipulative Media-Based Realistic Mathematical Education method, a complete achievement of 8% (2 students) achieved KKM on the pre-test increased to 92% (23 students) who achieved KKM on the post-test. These results indicate that learning classes using the Manipulative Media-Based Realistic Mathematics Education (RME) method are more effective in improving students' problem-solving abilities in mathematics.

3.1.2 Inferential Data Analysis

Inferential data analysis in this study aims to see the average comparison before and after being given treatment. The results of inferential statistical analysis to answer the research hypothesis that has been formulated. Before testing the hypothesis, it is necessary to test the assumption of normality.

3.1.2.1Normality Test

The normality test is carried out on the pre-test and post-test data of students' problem-solving abilities in mathematics. In this study, the normality test used was the Kolmogorov-Smirnov test with the Dallal-Wilkinson-Lilliefors correction. The normality test results using the Kolmogorov-Smirnov test with the Dallal-Wilkinson-Lilliefors correction are presented in Table 2.

Table 2. Normality Test Results

Kolmogrov-Smirnov	Pre-Test	Post-Tes
p-value	0.06	0.20
Information	Normal	Normal

Based on Table 2, information is obtained that the pre-test and post-test data normality tests of students' mathematical problem-solving abilities using the Manipulative Media-Based Realistic Mathematics Education method have a significance value that is greater than the alpha value of 0.05 (p-value > 0.05). Thus, the results of the normality test indicate that the null hypothesis is accepted and there is no reason to accept the alternative hypothesis.

3.1.2.2Hypothesis Testing the Effectiveness of Learning Mathematics using the RME method based on Manipulative Media

To test the effectiveness of the Realistic Mathematics Education method based on manipulative media in terms of student achievement in mathematics, the One-Sample T-Test is used. The student achievement data used in the test is post-test data compared to the KKM value that has been set, namely 70. The results of the One-Sample T-Test test is presented in Table 3.

Table 3. The results of the Effectiveness Test of Mathematics Learning using the Manipulative Media-based RME method

Paired-Sample Test	Pre-Test – Post-Test
p-value	0.00
Inormation	Effective

Based on Table 10, information is obtained that the resulting significance value is smaller or less than the alpha value of 0.05 (p-value <0.05). This shows that the null hypothesis (H_0) is rejected. Thus, learning using the Realistic Mathematics Education method based on manipulative media is effective in terms of student achievement in mathematics.

3.1.2.3Hypothesis Testing Differences in Problem Solving Ability between Before and After Using the Manipulative Media-based RME Method

To test students' problem-solving abilities in mathematics between before and after the application of the Realistic Mathematics Education method based on manipulative media, the Paired Sample T-Test is used . The learning achievement data of students used in testing are pre-test and post-test data. The test results of students' problem solving abilities in mathematics before and after the implementation of the Realistic Mathematics Education method based on manipulative media can be seen in Table 4.

Table 4. Test Results for Differences in Problem Solving Ability between Before and After the Use of the Manipulative Media-based RME Method

One-Sample Test	Post-Test
p-value	0.00
Information	There are Significant Differences

Based on Table 4, information is obtained that the results of the test for differences in the effectiveness of the pre-test and post-test data of students' learning achievement in mathematics have a significance value that is smaller or less than an alpha value of 0.05 (p-value <0.05). This shows that the null hypothesis (H_0) is rejected. Thus, it can be seen that after being given treatment there was a difference in learning before the application of the Realistic Mathematical Education (RME) method based on manipulative media and after the application of the Realistic Mathematical Education (RME) method based on manipulative media.

3.2. Discussion

Effective learning is learning that is active, interactive, creative, effective, and fun. In other words, effective learning is learning that can involve students in the learning process. One way that can be used so that students can be actively involved in learning is to use a variety of learning methods and media. Based on this, this study applied learning using the Realistic Mathematical Education (RME) method based on manipulative media in mathematics, material Volumes and Nets for Building Cube Spaces and Blocks for class V at SDN 4 MANURUNGNGE. This research was conducted in six meetings, three meetings without using the Realistic Mathematics Education (RME) method based on manipulative media, one pretest. Three meetings using the Realistic Mathematical Education (RME) method based on manipulative media, and one post-test with the material Building Cubes and Blocks and Nets of Cubes and Blocks.

The use of the Realistic Mathematical Education (RME) method gives a new color to the world of education, especially in mathematics, and can change students' views of mathematics. This research is in line with the opinion of Nurjamaludin et al. (2021), namely by using the Realistic Mathematical Education (RME) method, the ability to understand students' concepts increases and meaningfully encourages students to understand the relationship between mathematics and the world around them, students can be directly involved in the process of doing math so that they are not afraid to learn mathematics, and provide opportunities for students to develop their potential and alternative thinking skills.

This research is also in line with research conducted by Priciliya, Sunardi, Yudianto, & Susanto (2022) with the title "Real Mathematics Education (RME) to Improve Learning Outcomes and Mathematics Problem Solving Ability of Elementary School Students Grade IV SD Muhammadiyah Argosari". The results of this study revealed that after implementing Real Mathematics Education (RME) in class IV SD Muhammadiyah Argosari, student learning outcomes increased and reached the specified KKM standard of 70. Also, the use of the Realistic Mathematics Education (RME) method was able to improve mathematical problem-solving abilities of students. Students can understand the problems contained in the questions, are able to plan the right mathematical models to solve problems and are able to complete the mathematical models that are made.

Researchers also found the results of research conducted by Arfiani et al. (2020) with the title "Increasing Mathematics Learning Activity and Achievement Through a Realistic Mathematical Education (RME) Approach Assisted by Manipulative Media Class I SDN Karangkobar". The results of this study reveal that besides students being able to solve problems given by the teacher, students also seem to understand the material explained more easily, are more enthusiastic, active, and creative,

concentrate more and students are enthusiastic about participating in the learning process (Yulyanisa, Yerizon, & Asmar, 2021).

Learning mathematics by utilizing the Realistic Mathematics Education (RME) method based on manipulative media has a positive impact on students' problem-solving abilities. This can be seen from the results of the descriptive statistical analysis which shows that there is an increase in the percentage of KKM completeness of students by 92% from the previous 8% (2 students who achieved KKM, with a KKM score of 70) and after being taught using the Realistic Mathematical Education (RME) method based on manipulative media increased to 92% of students who completed KKM. The results of the descriptive statistical analysis were also reinforced by the results of inferential statistical analysis using the One Sample T-Test which showed that learning using the Realistic Mathematics Education (RME) method based on manipulative media was effective in improving students' problem-solving abilities in mathematics.

The results of the research support the research results of Nasution (2018) which states that the use of manipulative media has a positive impact on learning mathematics. In addition. The results of this study also support the research results of Sidik (2022) which states that the use of the Realistic Mathematic Education (RME) method based on manipulative media is very practical and effective in increasing students' problem-solving abilities in math learning.

From the results of data analysis, there are differences in the level of students' mathematical problem-solving ability before the application of the Manipulative media-based Realistic Mathematical Education (RME) method and after the application of the Manipulative Media-based Realistic Mathematical Education (RME) method. This means that the alpha hypothesis is accepted, namely the Realistic Mathematics Education (RME) method based on manipulative media influences the mathematical problem-solving abilities of students in class V at SDN 4 Manurungnge.

The effectiveness of the Realistic Mathematics Education (RME) method based on manipulative media in learning can be seen from the results of the Pre-Test and Post-Test which are proven through hypothesis testing where the results show that 0.000 <0.05 is proven by statistical analysis which states that the sig value < α, namely 0.000 < 0.05. Thus H_0 is rejected and H_1 is accepted. Thus, it can be stated that there are significant differences before and after the application of the Realistic Mathematics Education (RME) method based on manipulative media in class V SDN 4 Manurungnge. Based on research conducted by researchers regarding the effectiveness of the Realistic Mathematics Education method based on manipulative media, it was found that the Realistic Mathematics Education method based on manipulative media was effective in increasing students' solving abilities in mathematics.

4. Conclusion

Based on the results and discussion of research related to the effectiveness of the realistic math education (RME) method based on manipulative media in improving the problem solving skills of fifth grade students at SDN 4 Manurungnge, Bone Regency, it can be concluded: 1) students' problem solving abilities before being taught the Realistic Mathematical Education method (RME) based on manipulative media has an average value of 35.00, a standard deviation of 15.022 with a completeness percentage of 8% and after applying the Realistic Mathematics Education (RME) method based on manipulative media students' problem solving abilities have an average of 84, 20, the standard deviation is 8.602 with a completeness percentage of 92%; 2) learning using the Realistic Mathematical Education (RME) method based on manipulative media is effective in improving students' problem solving skills in mathematics; and 3) there is a difference between before and after the application of the Realistic Mathematical Education (RME) method based on manipulative media.

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